Office of Environment, Safety, and Health Oversight
Environment, Safety and Health

Comprehensive Fire Safety Review

The Hanford Site

October 2001

OVERSIGHT

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Abbreviations Used in This Report

CHG	CH2M HILL Hanford Group, Incorporated
DOE	U.S. Department of Energy
EH-2	Office of Environment, Safety and Health Oversight
ES&H	Environment, Safety and Health
FHA	Fire Hazards Analysis
FHI	Fluor Hanford, Incorporated
HFD	Hanford Fire Department
NFPA	National Fire Protection Association
ORP	Office of River Protection
PFP	Plutonium Finishing Plant
RL	Richland Operations Office
RLID	Richland Operations Office Implementing Directive
WESF	Waste Encapsulation and Storage Facility

Executive Summary

Scope and Background

This report documents the results of a review of fire safety programs at the Hanford Site performed by the U.S. Department of Energy (DOE) Office of Environment, Safety and Health Oversight, within the Office of Environment, Safety and Health, from August 6-16, 2001. The review focused on fire safety program implementation, hazard identification, and analysis processes, vital safety systems, and emergency services. Principal activities included a review of relevant fire protection program documents and interviews with Richland Operations Office and Office of River Protection project managers, Fluor Hanford, Incorporated and CH2M Hill Hanford Group, Incorporated managers and fire protection engineers, Hanford Fire Department personnel, subcontractors, and selected stakeholders. Facilities evaluated were deemed characteristic of the Hanford Site's diverse missions, operations, hazards, and corresponding safeguards, and included the Hanford Fire Department stations and training facilities, the Plutonium Finishing Plant, the Waste Receiving and Processing Facility, the Waste Encapsulation Storage Facility, the 242-S Evaporator, and the Cross-Site Transfer Facility.

This review was conducted as part of the DOE fire safety initiative, which was established following a series of wildfires in the year 2000. In October 2000, the Secretary directed the implementation of a multi-faceted initiative. Aspects of this initiative include a review of wildland fire vulnerability at DOE sites, the promulgation of a new wildland fire safety policy, the creation of an independent commission on fire safety, and the performance of a "comprehensive review" of DOE fire protection programs. In parallel with these activities, DOE responded to Defense Nuclear Facilities Safety Board Recommendation 2000-2, which pertained to the integrity of vital safety systems. In its implementation plan for 2000-2, DOE committed to include an examination of vital fire safety systems as part of the comprehensive review.

Results

Hanford Site fire safety programs are evolving in response to DOE safety management policy, changing operating conditions (e.g., establishment of the Office of River Protection), and past fire incidents at Hanford and other DOE sites. The Richland Operations Office is enhancing its fire safety program consistent with the Department's fire safety policy. The Richland Operations Office has renewed its commitment to fire safety and built upon the existing program foundation, as witnessed by the recently re-instated fire safety oversight activities in accordance with DOE directives. Fluor Hanford, Incorporated and CH2M Hill Hanford Group, Incorporated fire safety program administrative and operating procedures are consistent with DOE directives and applicable National Fire Protection Association codes and standards. Fluor Hanford, Incorporated and CH2M Hill Hanford Group, Incorporated generally implement formal processes to ensure that subcontracts contain appropriate fire safety clauses consistent with the integrated safety management system. Fire safety program implementation is characterized by a "defense-in-depth" approach to mitigating fire hazards. This includes controlling flammable materials and ignition sources, fire-rated compartmentalization and noncombustible building construction, automatic fire protection and suppression systems, and appropriately trained and equipped fire fighters. All Hanford Fire Department staff are adequately trained and equipped to address facility and wildland fire emergencies. Under the Hanford Site Fire Department's Fire Marshal Program, all Fluor Hanford, Incorporated and CH2M Hill Hanford Group, Incorporated fire protection engineers are recognized as Deputy Fire Marshals. Through frequent communication, these personnel collectively provide a consistent approach to fire protection at Hanford Site projects and associated facilities.

Prior to the creation of the Office of River Protection, all fire protection services were under the custody of the Richland Operations Office. When the Office of River Protection was formed, fire protection engineering services were not available onsite to support both the Richland Operations Office and Office of River Protection mission needs. Until recently, local DOE oversight of contractor fire safety programs has not been consistent with DOE requirements. Similarly, the Office of River Protection has only recently initiated efforts to establish a comprehensive fire safety program. Although efforts are planned, evaluating the impacts of wildland fires on facility safety have not been completed. Based on the vital safety systems evaluated during this review, weaknesses in the areas of configuration management and maintenance suggest that the ability of the fire protection systems to achieve their intended safety function may not be fully assured. Furthermore, technical safety requirements have not been developed for the Hanford Site water delivery system nor has apparent age-induced pipe degradation in the system been analyzed to assure that a sufficiently reliable source of water is maintained available for suppressing a design basis fire originating in Building 2736-ZB. In the area of hazards analysis, the established program to control excessive accumulations of combustible materials and possible ignition sources within the Plutonium Finishing Plant is not effective.

Conclusions

In general, fire safety is being adequately addressed at the Hanford Site. The Hanford Fire Department, which includes the Fire Marshal Program, provides exemplary fire protection and emergency services. Richland Operations Office management commitment to fire safety is evident. Although efforts are improving, the Office of River Protection has not been effective in obtaining the resources necessary to implement a rigorous fire protection program. Hanford Site contractors are demonstrating a commitment to ensuring fire safety; however, some instances were identified where Fluor Hanford, Incorporated and CH2M Hill Hanford Group, Incorporated fire safety program activities were not being implemented consistent with the integrated safety management framework. Additional management attention is warranted to mitigate the effects of aging on vital safety systems and equipment, including those that provide necessary support functions. Additionally, the Office of River Protection needs to complete their efforts to establish a fire safety program on a timely basis.

This review identified the following two safety deficiencies, which should be addressed through development of formal corrective actions and tracked locally using the site's corrective action systems and processes.

SAFETY DEFICIENCIES IDENTIFIED IN HANFORD FIRE SAFETY REVIEW

1. **The Office of River Protection has not established a formal fire safety program consistent with DOE policy and guidance as contained in DOE Policy 450.4, *Safety Management System Policy*, and DOE Order 420.1, *Facility Safety*.**

2. **Technical safety requirements have not been developed for the Hanford Site water delivery system nor has apparent age-induced pipe degradation in the system been analyzed to assure that a sufficiently reliable source of water is maintained available for suppressing a design basis fire originating in Building 2736-ZB.**

1.0 Purpose and Onsite Activities

Background and Purpose. This report documents the results of a review of fire safety programs at the Hanford Site (see Figure 1), which was performed by the U.S. Department of Energy (DOE) Office of Environment, Safety and Health Oversight (EH-2), within the Office of Environment, Safety and Health, from August 6-16, 2001. The purposes of this review were (1) to assess the effectiveness of fire safety features and programs and emergency response capabilities; (2) to evaluate line management's commitment to ensure the operational integrity of "vital" fire protection systems; and (3) to verify the implementation of select wildland fire safety enhancements. The review focused on fire safety programs, hazard identification and analysis processes, vital safety systems, and emergency services.

This review was conducted as part of the DOE fire safety initiative, which was established following a series of wildfires in the year 2000. The Cerro Grande wildfire in and around the Los Alamos National Laboratory in New Mexico resulted in significant loss of private property and natural resources; wildland fires also occurred at DOE's Hanford Site and the Idaho National Engineering and Environmental Laboratory, among other locations. In October 2000, the Secretary directed the implementation of a multi-faceted initiative. Aspects of this initiative include a review of wildland fire vulnerability at DOE sites, the promulgation of a new wildland fire safety policy, the creation of an independent commission on fire safety, and the performance of a "comprehensive review" of DOE fire protection programs. In parallel with these activities, DOE responded to Defense Nuclear Facilities Safety Board Recommendation 2000-2, which pertained to the integrity of vital safety systems. In its implementation plan for 2000-2, DOE committed

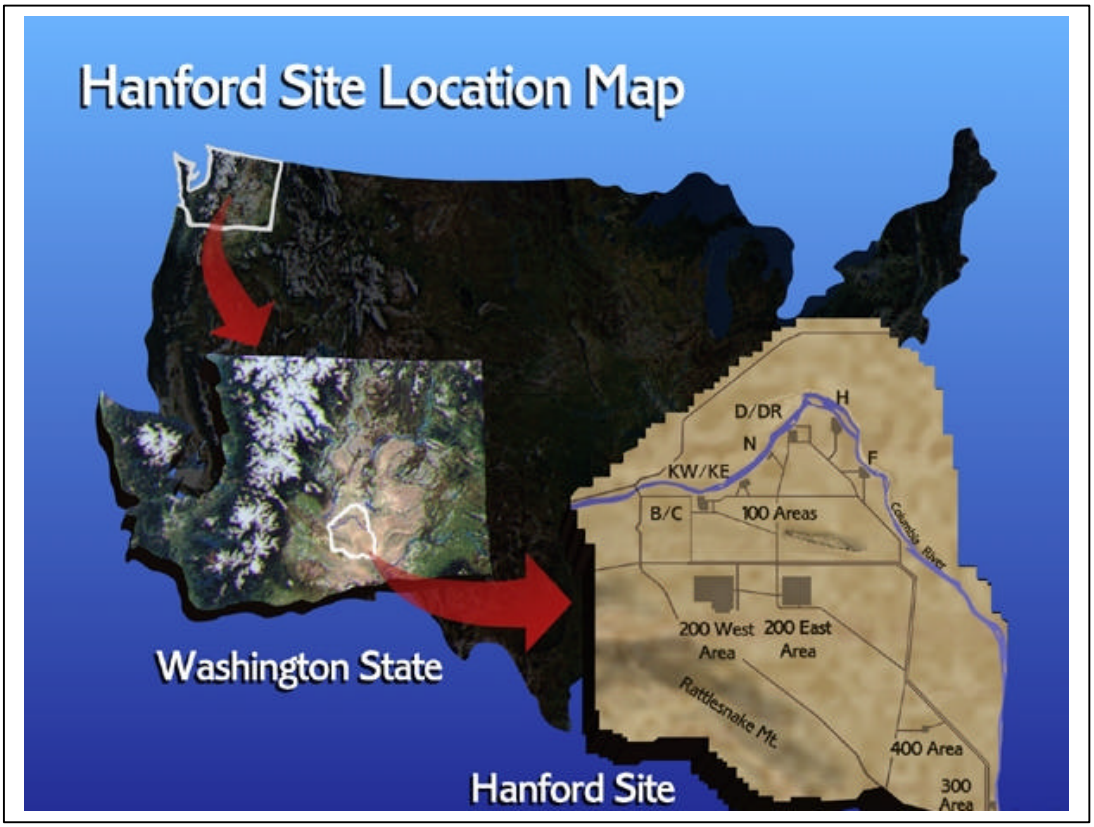


Figure 1. Hanford Site Schematic

to include a review of vital fire safety systems as part of the comprehensive review.

Onsite Activities. The onsite portion of this review was conducted from August 6-16, 2001. Principal activities included a review of relevant fire protection program documentation such as site policies, fire prevention procedures, authorization basis documents, fire hazards analyses and assessment reports, representative contracts, fire department baseline needs assessment, fire pre-plans, and standard operating procedures. A significant number of such documents were reviewed by team members prior to their arrival on site. Additionally, interviews were conducted with cognizant personnel, including Richland Operations Office (RL) and Office of River Protection (ORP) program managers, Fluor Hanford, Incorporated (FHI), and CH2M Hill Hanford Group, Incorporated (CHG) managers and fire protection engineers, fire department personnel, subcontractors and staff, and selected stakeholders.

Representative facilities were walked down that were deemed characteristic of the site's diverse missions, operations, hazards, and corresponding safeguards, including the Hanford Fire Department (HFD) stations and training facilities, the Plutonium Finishing Plant (PFP), the Waste Receiving and Processing Facility, the Waste Encapsulation Storage Facility (WESF), the 242-S Evaporator, and the Cross-Site Transfer Facility. Fire protection system inspection, testing and maintenance records, and personnel training records were also evaluated. As part of this review, vital systems at the PFP, WESF, and the 242-S Evaporator were examined, and selected work activities were observed.

Plutonium Finishing Plant

Section 2 provides the results of the review. Appendix A describes the Hanford Site and the key facilities that were examined. Appendix B provides the complete analysis of vital safety systems performed by the review team (this analysis is also summarized and provided as part of Section 2). Appendix C provides the team composition.

2.0 Results

This independent review of fire safety programs at the Hanford Site characterizes the strengths, weaknesses, and safety deficiencies associated with fire safety programs (Section 2.1), hazard identification and analysis processes (Section 2.2), vital safety systems (Section 2.3), and emergency services (Section 2.4). Appendix B provides a more complete discussion of the vital safety systems review.

2.1 Fire Safety Program

Overview of Fire Safety Program

Hanford Site fire safety programs are evolving in response to DOE safety management policy, changing operating conditions, past fire incidents at Hanford and other DOE facilities, and recent independent assessments by a variety of organizations internal and external to the Hanford Site, including Facility Evaluation Boards, Independent Performance Evaluation groups, and DOE Headquarters organizations. RL is in the process of enhancing its fire safety program consistent with the Department's fire safety policy. For example, RL recently initiated fire safety assessments of contractor operations in accordance with its oversight responsibility, an activity that had not been performed in accordance with DOE requirements in past years. ORP has not established a formal fire safety program. Currently, ORP is developing a draft of its implementing document, and a planned programmatic fire safety assessment of CHG is behind schedule. Two principal DOE contractors that report to RL and ORP — FHI and CHG, respectively — have established comprehensive fire protection programs consistent with the fundamental elements contained in DOE Orders and related guidance. Although DOE, FHI, and CHG take precautions to mitigate the risk of wildland fires and have enhanced their emergency response capabilities, their respective fire safety programs and implementing documents, in addition to facility authorization bases, fire hazards analyses, and fire prevention procedures, contain only minimal explicit criteria directly applicable to wildland fire safety. RL is expected to remedy this with the completion of three corrective actions contained in the Command 24 Improvement Action Program Plan.

Management Commitment to a Documented and Comprehensive Program

RL management commitment to fire safety is evident at the Hanford Site.

RL has begun to demonstrate a renewed commitment to fire safety. First-level delegations of fire safety responsibilities from the RL Manager to senior staff are contained in the RL *Safety Functions, Responsibilities, and Authorities Manual*. Further clarification of fire protection authorities, roles, and responsibilities are provided in RL's *Fire Safety Program Description* document and related implementing directives (RLIDs). Collectively, these documents describe the RL fire safety program scope and objectives, including expectations, applicable

242-S Waste Evaporator Building

codes and standards, requisite training, and assessment requirements. Recently, RL has been aggressively seeking to acquire an additional fire safety engineer to augment its one fire protection engineer. This action further indicates management's commitment to developing a program consistent with the fire hazards within its purview, and to recognizing the level of fire safety expertise needed to adequately perform the necessary oversight of the contractor.

ORP efforts to establish a formal comprehensive fire safety program have not been timely.

ORP's *Safety Functions, Responsibilities, and Authorities Manual* defines senior level responsibilities for worker safety and health. However, the ORP fire safety program description is in draft form and has not been released. Further, ORP has no full-time fire protection engineer dedicated to developing and implementing its fire safety program, which would include providing fire safety oversight of the tank farms and the vitrification plant. While compensatory measures have been established, they contain inherent weaknesses. Specifically, memoranda of agreement (dated December 2000 and August 1, 2001), defining RL and ORP roles and responsibilities at the Hanford Site, also contain provisions for ORP to acquire fire protection technical support from RL on an "as-negotiated basis." However, ORP's efforts to obtain the level of fire safety subject matter expertise needed to launch and sustain an adequate program have been limited due to RL having only one fire protection engineer. Accordingly, ORP recently engaged a contractor to provide fire protection support services. ORP management maintains that there is insufficient funding available for the balance of the current and following fiscal years to hire an ORP fire safety engineer, and it is expected that funding will be available for only partial contractor support for fire protection.

FHI and CHG management support to fire safety is evident.

Fire safety expectations are delineated in administrative procedures, fire protection directives, contractual agreements, and a series of supplementary policies, program descriptions, procedures, and guidelines. Collectively, these documents address fire hazard identification and evaluation, provision of appropriate fire prevention measures and features, and timely feedback on program effectiveness. FHI's *Fire Protection Program Overview & Responsibilities* procedure specifies its fire safety policy, roles and responsibilities, required training, and applicable procedures and related documents. CHG's fire protection program is clearly defined in administrative procedure HNF-IP-0842, *Fire Protection Program*, which addresses policy, roles and responsibilities, requirements, applicable procedures, and records management. FHI and CHG fire protection engineers provide subject matter expertise to their projects and ensure effective implementation of their respective fire protection programs. Further, FHI and CHG resources are being applied to upgrade facility fire protection and enhance the HFD emergency response capabilities. At the facilities reviewed, sufficient resources were allocated to fire safety program upgrades for maintaining safety and meeting requirements and codes. The HFD is sufficiently funded to implement sitewide wildland and facility fire protection programs. Although FHI's and CHG's fire safety programs are consistent with DOE facility fire safety policy, explicit attention to wildland fire safety is cursory.

Flow Down of Fire Safety Program Requirements

The requirements for Hanford Site fire safety programs are clearly defined in contractual agreements and are based on DOE directives and industry codes and standards.

RL's and ORP's respective contracts with FHI and CHG contain standards/requirements identification documents that prescribe contractor and project-specific fire safety program requirements. The standards/requirements identification documents, which are developed by FHI and CHG and approved by DOE, supercede all other environment, safety, and health requirements (including fire safety) and mandate compliance with National Fire Protection Association (NFPA) codes and standards. Current standards/requirements identification documents also impose the requirements contained in RLID 5480.7, *Fire Protection*, a document jointly developed by the contractors and RL to supplement and clarify fire safety program implementation expectations. Although both RL and ORP are now working with their contractors

to transition to the current generation of DOE fire safety directives, until this transition is complete, implementation of the more prescriptive requirements of the current standards/requirements identification documents provides an acceptable level of fire safety.

Both FHI and CHG have robust procedures for managing their respective environment, safety, and health requirements identification processes, and for interfacing with DOE when changes in mission or requirements warrant modification.

These procedures require timely standards/requirements identification document revision when necessary, DOE review and approval, documented verification of the existence of procedures to implement requirements, annual contractor review and accuracy certification, and triennial documented verification that the procedures are being implemented. Further, each contractor is introducing sophisticated electronic requirements management databases that provide traceability for implementing procedures to and from their source requirements. These databases will facilitate compliance audits and avoid inappropriate procedure changes that might lead to violations of requirements.

Although weaknesses exist, FHI and CHG implement formal processes to ensure that subcontracts contain appropriate fire safety clauses consistent with the integrated safety management system.

Subcontracting procedures and clauses require that subcontractors flow down appropriate integrated safety management system clauses to lower tier contractors. Both FHI and CHG subcontracts contain a statement of work and, where applicable, standard "special provisions" that flow down integrated safety management system requirements. The statement of work is required to include identified hazards and appropriate hazard controls, such as fire safety program requirements. When enlisted by the authors of the statement of work, fire protection engineers assist in the review and development of the statement of work by defining fire safety hazards and recommending applicable fire safety requirements. While FHI and CHG use an integrated safety management system flow down clause checklist in their respective procurement processes to determine "required reviews" of statements of work, neither stipulate that a fire protection engineer must review all work that has the potential to degrade the fire safety program or to challenge fire protection features. Further, the automated job hazards analysis program used by FHI and CHG contains weaknesses, including allowing the identification of hazards without stipulating corresponding controls, not permitting other reviewing safety professionals to mandate a fire protection engineer review and concurrence, and not automatically requiring such a review in situations obviously pertinent to fire safety. Accordingly, existing formal processes to flow down fire safety program requirements to subcontractors could result in statements of work that do not adequately address fire safety.

DOE Oversight of Contractor Operations and Corrective Action Management

DOE oversight of contractor fire safety programs has not been consistent with DOE requirements.

Formal biennial assessments of contractor fire safety programs have not been performed. To address this deficiency, RL recently prepared a challenging schedule and completed two programmatic fire safety evaluations of contractor operations. The ORP integrated assessment schedule identifies planned fire safety oversight activities for July 2001 that have neither been performed nor rescheduled, as a formal ORP program of fire safety oversight has not been institutionalized.

DOE oversight of contractor operations is principally provided by Facility Representatives, who generally identify fire safety weaknesses during routine monitoring and surveillance activities. Although Facility Representative Program Surveillance Guide 12.2, *Fire Protection and Prevention*, was developed to ensure that contractors implement effective fire safety programs, it is frequently not used to perform comprehensive programmatic assessments. The RL Deficiency Tracking System is used to capture fire safety concerns identified by Facility Representatives during their oversight actions. Information contained in the Deficiency Tracking System is transmitted to FHI project personnel monthly for appropriate response and action, tracked to closure, and analyzed for trends

to improve the effectiveness of assessments and corrective actions. ORP's recently established Consolidated Action Reporting System is not used to capture fire safety concerns, although it can be easily modified to accommodate oversight findings. ORP personnel are continuing to receive awareness and user training on the Consolidated Action Reporting System. In the interim, findings from Facility Representative oversight activities of ORP contractor operations are being captured by the CHG Action Tracking System. Additionally, Facility Representatives assigned to ORP are beginning to more frequently review problem evaluation requests, which are used to capture deficiency and corrective action information maintained in the CHG database.

Contractor Self-Assessment and Corrective Action Management

FHI and CHG have established a variety of mechanisms, processes, and associated procedures for assessing, reporting, tracking, and analyzing fire safety hazards in their respective projects.

Each contractor is required to perform annual or triennial facility-level fire protection program assessments using qualified fire protection engineers. FHI fire protection engineers, who are recognized as Deputy Fire Marshals, also perform facility inspections and periodic informal walkthroughs that are supplemented by the results of less focused surveillance activities conducted by project-specific quality assurance personnel. FHI fire protection engineers generally do not conduct first-hand surveillances of HFD inspection, testing, and maintenance activities performed on fire suppression systems and related equipment, but are required to review the records pertaining to such actions. FHI maintains a record of fire protection assessments for purposes of preparing annual schedules for such activities. CHG prepares a three-year fire protection facility assessment schedule to be executed by its two fire protection engineers.

FHI and CHG self-assessments are generally not based on rigorous analysis of previously reported deficiencies and associated corrective actions.

FHI fire safety deficiencies are reported and given a risk ranking value by the Deficiency Evaluation Group; the risk rank value provides an indication of the severity of the deficiency and the minimum rigor required for its management. Generally, if the deficiencies represent a violation of a requirement, then they are entered into the Deficiency Tracking System for corrective action tracking and analysis for trends. However, corrective actions associated with requirements violations are not always rigorously tracked to ensure timely closure or that appropriate interim measures are implemented. For example, numerous sprinkler heads at WESF were painted during maintenance activities, a violation of

NOTEWORTHY PRACTICES

The Hanford Fire Department provides sitewide emergency response capabilities and associated support services, maintains building pre-fire plans, and performs building-specific fire prevention surveillances. The Hanford Fire Department is responsible for inspection, testing, and maintenance of all active fire protection systems and equipment. The Hanford Fire Marshal Program facilitates a comprehensive and consistent approach to implementing fire safety at the Hanford Site. All contractor fire protection engineers are recognized as Deputy Fire Marshals under the Fire Marshal Program, and collectively comprise the fire protection engineering staff tasked with dispensing fire safety expertise to all Hanford Site projects and facilities, including participating in fire safety design reviews, preparing fire hazard analyses, developing and modifying fire safety programs, and issuing hazard-specific work and building occupancy permits. As Deputy Fire Marshals, contractor fire protection engineers meet monthly as members of the Fire Marshal Advisory Board. These board members, along with the Hanford Fire Department's fire system testing and maintenance personnel and the Richland Operations Office fire protection engineer, meet quarterly as the Hanford Fire Forum to coordinate activities and discuss fire safety issues, initiatives, and lessons learned. These meetings provide significant benefits, such as enhanced fire safeguards at reduced costs and improved communication on important fire safety issues.

National Fire Protection Association standards. Although replacement equipment was installed after six months, no interim compensatory measures were taken. Fire safety deficiencies identified by FHI personnel and given the minimum risk rank value by the Deficiency Evaluation Group are entered into a project-specific corrective action tracking system (maintained at the relevant facility). Generally, these deficiencies are neither analyzed for trends nor rigorously tracked to closure; however, deficiencies identified by Facility Representatives, regardless of Deficiency Evaluation Group ranking, are always entered into the Deficiency Tracking System and analyzed for trends. Facility Representatives sometimes attend Deficiency Evaluation Group meetings and contribute to the Deficiency Evaluation Group process as well as make note of those FHI-identified deficiencies that are given a minimum risk ranking and not entered into Deficiency Tracking System, but are worthy of continued tracking by Facility Representatives for timely and adequate closure. CHG also employs Deficiency Evaluation Groups to assign risk rank values to fire safety deficiencies. All CHG deficiencies are entered into the Action Tracking System for tracking regardless of the risk rank value assigned. However, consistent with previous independent assessments of the CHG corrective action management system, the Action Tracking System database is underused as a management tool. Information is not easily accessed and data on fire safety deficiency root causes are not rigorously analyzed for trends to facilitate the development of effective fire safety corrective actions. Concurrent with CHG's efforts to convert the computer-based Action Tracking System to a web-based format that will use Problem Evaluation Requests to capture information on fire safety deficiencies, CHG quality assurance personnel are preparing to initiate more rigorous analyses on deficiency and corrective action data.

Personnel Competency in Fire Safety

All DOE personnel receive Hanford General Employee Training that addresses fundamental aspects of fire safety, including alarms and fire extinguishers.

Although Facility Representatives do receive additional fire safety training as part of their qualification program, those RL and ORP personnel responsible for performing oversight — project managers, Facility Representatives, and quality assurance staff — generally do not receive specialized Hanford fire safety hazard awareness training to enhance their competency to perform assigned duties. For example, general employee training focuses on individual response to fire emergencies, such as alarm recognition and appropriate action, and does not adequately address fundamental elements of fire safety like combustible loading. While RL and ORP Facility Representatives have access to the RL fire protection subject matter experts to supplement their knowledge base, the availability of such support to ORP is limited. Efforts by ORP to compensate for this situation by providing its oversight personnel with additional training or acquiring long-term dedicated expert support have not been aggressive.

Specialized fire safety hazard awareness training for FHI and CHG personnel is addressed in addition to Hanford General Employee Training.

In addition to Hanford General Employee Training, FHI utilizes an automated employee job task analysis system to identify and schedule personnel for general and specialized training based on work assignment. Some specialized fire safety training is available to FHI workers, such as fire watch, bayonet fire extinguisher (for glovebox application in the PFP), and other fire safety-related courses for surveillance and building management personnel. Individuals reviewing FHI and CHG fire safety programs, including plant personnel and members of independent management assessment teams, such as Facility Evaluation Boards, do not receive any specialized fire safety assessment training.

RL and CHG fire protection engineering staff meet the DOE fire protection qualification standard. While the standard is applicable to DOE federal employees, CHG has voluntarily applied the standard to their staff. The standard has not been applied to FHI fire protection engineers. Except for the lack of recent participation by RL and some contractor fire protection engineers at DOE fire safety workshops, the fire protection engineering staff appears to be sufficiently qualified and adequately trained to perform their assigned duties. Additionally, HFD and facility personnel have training and qualifications commensurate with their responsibilities for inspecting, testing, and maintaining fire protection systems.

Sprinkler Line in 242-S

Stakeholder Involvement

The Hanford Advisory Board, established in 1994, provides advice and recommendations to the DOE and other Federal, state, and local government organizations on major clean-up items of interest at the Hanford Site. Hanford Advisory Board members include representatives from all levels of government, Native American tribes, public interest groups, academia, businesses, site workers, and citizens. Hanford Advisory Board work is principally accomplished through five committees: the Dollars and Sense; Environmental Restoration; Health, Safety, and Waste Management; Public Involvement; and Tank Waste Ad Hoc Committees. DOE, in conjunction with the Hanford Advisory Board, generally holds six public meetings annually at locations throughout the region. Budget considerations are usually addressed in meetings held in February and March. Tri-party agreements are discussed in meetings held in June and September. When possible, the DOE presents proposed budgets for specific line items or a prioritized list of proposed activities for review and comment by all stakeholders. Additionally, stakeholders are apprised of emergency management program activities, and they participate in developing, conducting, and critiquing emergency response exercises.

Facility fire prevention is important to stakeholders and perceived as being effectively managed by the Hanford Site.

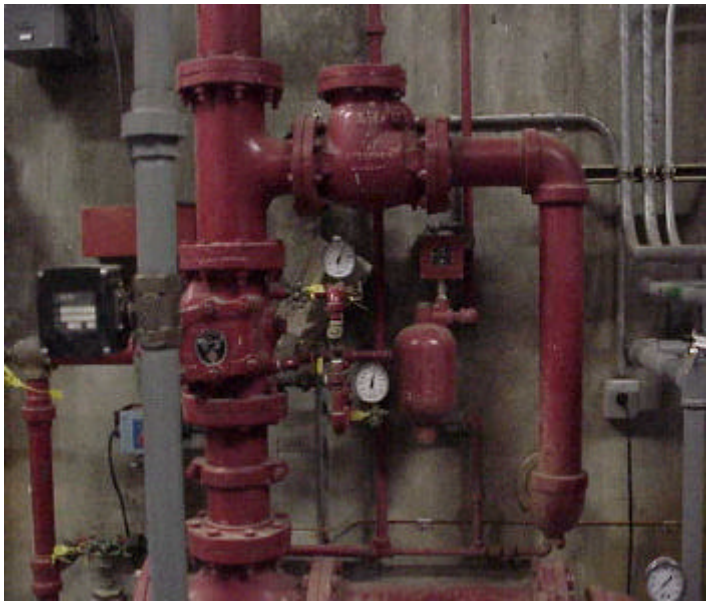
The Hanford Advisory Board's principal focus is on clean-up in three areas: plutonium stabilization and spent fuel; the vitrification facility; and tank farm remediation. Despite this focus, communication between stakeholders and Hanford Site personnel on fire safety concerns is improving, as lessons learned are being aggressively reviewed for application. For example, with Hanford Advisory Board involvement, DOE has re-instituted an aggressive program of precautionary "controlled" burning of tumbleweeds that have accumulated along site boundary fences; this activity had been suspended the previous year.

DOE recognizes its responsibility to establish a program with the state, local counties, and hospitals to protect the public in the event of an emergency.

Effective interfaces are established and maintained to ensure that emergency response activities are integrated and coordinated with the Federal, tribal, state, and local agencies, and organizations responsible for emergency response and protection of workers, the public, and the environment. The Hanford Site Emergency Plan contains numerous memoranda of agreement, established with county and state agencies, and local fire departments and hospitals, that form a basis for communicating roles and responsibilities, dispatching mutual aid, carrying out emergency operations, and providing for treatment and care of patients in an emergency. Further, DOE has established a process to ensure that these agreements are routinely reviewed and updated when necessary.

2.2 Hazard Identification and Analysis Processes

A variety of methods and documents at the Hanford Site identify and analyze fire hazards and related events. These include, but are not limited to: authorization basis documents, fire hazards analyses, fire protection engineering self-assessments, HFD inspections, Health and Safety Plans, and job hazard analyses. Fire prevention and protection safeguards include combustible materials and ignition source control procedures, employee (fire) safety training, noncombustible construction, compartmentalization, manual fire fighting equipment, automatic fire suppression systems, and the response capabilities of the HFD.



Automatic Sprinkler Riser in 242-S

A review of authorization basis documents, fire hazards analyses and self-assessments for PFP, the 242-S Evaporator, the Waste Receiving and Processing Facility, and the Cross-Site Transfer Facility revealed that the fire hazard identification process remains incomplete. Although these analyses were developed to be in accordance with the requirements of DOE Order 5480.7A, a variety of hazards were not identified, including fire effects on "mission critical" equipment and facilities, smoke migration through the facility (High Efficiency Particulate Air filter clogging by smoke was considered), effects of fire fighting water on sensitive equipment, construction-related fire hazards with W-460 facility modifications, selected welding operations in PFP, and wildland fire risks in all facilities.

Preservation of "program continuity" is one of the four historic goals of the DOE fire protection program, as delineated in DOE Orders. Critical mission deadlines might not be met if facilities or process lines were destroyed or damaged by fire. Consideration of the effects of "smoke migration" and "fire fighting water" is explicitly delineated in the 1995 Implementation Guide to DOE Order 420.1, *Facility Safety*. While this Guide is not considered mandatory, it represents the collective judgment of the DOE Fire Safety Committee regarding the desired level of comprehensiveness of fire hazards analyses. Although construction and welding fire hazards, among others, are nominally addressed by other site procedures, facility walkdowns conducted as part of this assessment revealed instances – such as scaffolding obstruction of ceiling (fire) sprinklers, accumulations of combustible materials, and the arrangement of portable "load centers" – where these procedures have not been completely effective in eliminating fire hazards.

Hazards that have been incompletely evaluated include "unbounded" fire hazards from the fire hazards analysis and fire protection water discharge onto the "duct level" in PFP. "Water runoff" in PFP is illustrative of a broader deficiency. While the fire hazards analyses reveal that contamination spread by sprinkler runoff was considered (an explicit DOE requirement), the fire hazards analysis did not address the possible adverse consequences of water from sprinklers or fire hoses accumulating on the permeable floor/ceiling assembly above the production area. Consequently, there may be significant fire hazards and related phenomenon (such as water discharge onto sensitive process equipment and safety systems) for which insufficient mitigation exists.

Some fire hazard analyses did not "comprehensively assess the risk from fire"; others did not appropriately apply fire-modeling parameters.

A review of selected fire hazards analyses revealed one instance where a fire-modeling parameter was misapplied and another where an anomaly was discovered in the analytical process. An FHI fire protection engineer identified both anomalies as part of a review of the fire hazards analyses. Recalculating the model indicated that the resulting "credible" fires were determined to be more severe than originally estimated. One error, involving the use of "soot deposition factors," has been corrected with no adverse effect on the safety envelope. The other, related to the application of "heat of combustion," is being reevaluated for potential impact at other facilities. The most severe consequence of this re-evaluation might involve identification of credible fires in other facilities that result in significantly higher levels of fire damage than previously determined. However, the conservative assumptions and methodologies used in the fire modeling process may mitigate any impacts on the margin of fire safety.

The established program to control excessive accumulations of combustible materials and possible ignition sources within the Plutonium Finishing Plant is not fully effective.

FHI has a program to control combustible materials and ignition sources that include written procedures coupled with facility inspections by fire protection engineers, facility managers, and the maintenance staff. Determining the presence of excessive combustibles is primarily at the discretion of the individual. Although certain categories of combustibles, such as untreated lumber, are prohibited, there is significant evidence that this program is not fully successful in controlling combustible accumulations and ignition hazards within PFP. Facility walkdowns revealed several locations where the volume of combustible materials was excessive.

The DOE Facility Representatives have issued a recent Surveillance Report documenting the presence of significant quantities of transient combustibles and indicated that this is a recurring problem. A number of portable load centers were observed in PFP with potentially unsafe wiring arrangements that could represent a source of ignition. As a consequence of this condition, fires may be more likely to occur. Once ignited, the additional combustibles might produce a fire that is more severe than those that have been analyzed, although such a fire would likely be controlled by installed fire suppression systems.

Some FHI work packages and activities do not fully implement Integrated Safety Management System core functions to ensure that the risks from fire safety hazards are reduced.

Although FHI has procedures that include the use of the automated job hazards analysis process, reviews of work packages and work activities indicate that fire safety concerns are not fully identified during the scope of work, and the hazard identification process does not ensure that potential fire risks are fully addressed. The review team identified the improper use and handling of flammable liquids, improper identification of personal protective equipment, improper disposal of used shop rags, and the absence of required mitigating features during the work activity.

A review of work packages that were designated "ready to work" identified automated job hazards analyses that were not completed and did not comprehensively identify tasks having fire related hazards (including hot work and use of chemicals). Pre-job walkdowns are not routinely conducted in the formation of the automated job hazards analysis to further identify potential hazards. Automated job hazards analyses are not updated for work packages that span a long period of time and for which conditions may have changed or for work packages that have been temporarily held for additional information. Additionally, the facility fire protection engineer is not routinely involved in developing appropriate hazard controls and identifying applicable safety standards and requirements for work packages.

2.3 Vital Safety Systems

In Recommendation 2000-2, the Defense Nuclear Facilities Safety Board (or Board) recommended improvements to the configuration management of vital safety systems, and defined vital safety systems as safety-class, safety-significant, and defense-in-depth. A September 8, 2000, letter to the Secretary of Energy amplified the intent of Recommendation 2000-2 and defined the thrust of the Board's Recommendation to be the assessment of the operational readiness of vital safety systems. The Board stated that as facilities age, a combination of degradation and less than effective implementation of preservation programs (e.g., change control, upgrades, and maintenance) might affect system reliability and ability to perform design safety functions.

In response to Recommendation 2000-2, FHI, under the guidance of Federal field office personnel, performed an initial tabletop assessment (Phase I) of vital safety system operational readiness. This was accomplished by identifying the vital safety systems within selected defense nuclear facilities, reviewing existing operational and maintenance records, and qualitatively determining a readiness state for each vital safety system. To assure consistency, a basic set of criteria was developed to guide the performance of the Phase I assessments. The 2000-2 Phase I assessment concluded that the Hanford Site's vital fire protection systems fully satisfied the assessment criteria.

The primary objective of this vital systems review was to evaluate the "health" of selected fire protection systems at the Hanford Site. The EH-2 review team applied vertical slice methods using the *Evaluation Plan,*

Department of Energy Facility Fire Safety Review, May 2001. Observations addressed the ability of the fire protection systems to perform safety functions considering the as-built/as-designed conditions, and configuration management, operation, and maintenance requirements. Selected fire protection systems at the PFP facility were reviewed first; the results were used to focus the reviews conducted at WESF and 242-S. Detailed observations and conclusions for all facility reviews are presented in Appendix B.

As-built versus as-designed discrepancies were observed at PFP, WESF, and 242-S. Other deficiencies, delineated in Appendix B, were also identified in the configuration management and maintenance of fire protection systems at PFP, WESF, and 242-S. Although specific deficiencies varied among these facilities, collectively they indicate weaknesses that are more generic. With respect to conduct of operations and maintenance, instances of procedural noncompliance, procedural deficiencies, lack of vendor manual controls, and system preconditioning (i.e., the manipulation of a system to clear a problem before performing a test) were observed. Further, previously identified long-standing open items have not been closed, and the additional commitment to resolve fire protection concerns in a timely manner has not been realized.

At PFP, completion of a new fire hazards analysis while the 2000-2 Phase I assessment was being conducted raised substantial questions about the adequacy of the analyses and assumptions contained in the fire hazards analysis of record; specifically, the maximum possible fire loss scenario at Building 2736-ZB. The new fire hazards analysis concluded that the maximum possible fire loss would result from a postulated fire reaching flashover temperatures and involving the entire hot side of 2736-ZB. This design basis fire, if unmitigated, could result in unacceptable, postulated onsite and offsite accident doses. As described in Occurrence Report RL-PHMC-PFP-2001-0001 and letter FH-01003667 dated January 19, 2001, the newly defined fire created an unreviewed safety question for the facility.

This emerging unreviewed safety issue was appropriately identified in the 2000-2 Phase I assessment pursuant to guidance provided for Commitment 3 of the Department's response to Recommendation 2000-2. The PFP fire protection system was subsequently rated "Green" (indicating satisfactory) during an evaluation of the Phase I results in accordance with Commitment 6. The team believes that a "Green" rating does not accurately reflect the status of the PFP fire protection systems considering the emerging and unresolved fire protection issues outstanding in Building 2736-ZB.

Additionally, the team identified a safety deficiency concerning the lack of technical safety requirements for the Hanford Site water delivery system and a failure to fully analyze the potential impact of age-induced buried pipe degradation on fire protection system operability as described below. Pursuant to DOE Recommendation 2000-2 implementation guidance, the water delivery system was identified during the PFP fire protection system Phase I assessment as a vital support system and the Criteria, Review and Approach Documents (CRADs) were not applied. The team believes that guidance to exclude support systems from the Phase I CRADs, while screening vital systems from Phase II based upon Phase I results, may result in significant safety deficiencies in support systems remaining unknown to the Department.

Technical safety requirements have not been developed for the Hanford Site water delivery system nor has apparent age-induced pipe degradation in the system been analyzed to assure that a sufficiently reliable source of water is maintained available for suppressing a design basis fire originating in Building 2736-ZB.

RL subsequently approved a Justification for Continued Operation which allowed operation under the open unreviewed safety question until October 31, 2001. The Justification for Continued Operation proposed mitigating actions necessary to allow planned activities to proceed in 234-5Z and 2736-ZB. These actions included establishing extensive new controls on the fire protection system such as new limiting conditions of operations and surveillance requirements to reduce the probability and consequence of the design basis fire. In addition, DOE's approval specifically required that FHI investigate the feasibility of designating the fire sprinkler system as a safety class or safety significant structure system or component and consider changes to the infrastructure regarding the design, procurement, and maintenance of the 2736-ZB sprinkler system per DOE O 420.1 and NFPA requirements.

The new limiting conditions of operations have been implemented to ensure fire suppression system operability in Building 2736-ZB. However, the EH review team found that technical safety requirements had not been developed on the Hanford Site's water

delivery system to ensure that the Building 2736-ZB fire suppression system can adequately perform its intended safety function during a design basis fire.

The review team also found that the Hanford Site's water delivery system is experiencing buried pipe failure, a consequence of the aging Hanford infrastructure and water delivery system hydraulic transients (water hammer). To date, degradation of the water delivery system nor water hammer have directly affected operability of PFP fire protection systems. Degradation has been analyzed and portions of the system have been upgraded or prioritized for future replacement based primarily on environmental or water utility issues. However, the material condition observed in similar buried water delivery piping, including failures of potable water lines servicing other facilities and the recent water delivery system hydraulic transients (water hammer) in the water delivery system have not been analyzed for their generic impact on the PFP fire suppression system's ability to meet its intended safety significant function.

The review team identified these issues as a significant safety deficiency.

2.4 Emergency Services

The objective of this aspect of the fire safety assessment was to determine whether the HFD equipment, training, and procedures meet the appropriate standards established by DOE policy and provide appropriate protection to the site personnel and facilities in the event of an emergency including wildland fires. The HFD has comprehensive operating procedures that define emergency service roles and responsibilities. The HFD has developed pre-fire plans for all significant facilities and site areas. The incident command system is the basis for the emergency response philosophy as well as the operating procedures used. These procedures are written to meet the DOE requirements and those set forth in the Washington State Administrative Code. They also establish the requirements for requesting off-site responders to assist in wildland fire fighting.

The Hanford Fire Department maintains a highly trained and professional staff that provides emergency response services to the entire Hanford Site.

The HFD provides the personnel, mobile apparatus, and equipment resources for responding to facility fires, wildland fires, and medical emergencies, among other responsibilities. As the first responders to onsite events, they serve as incident commanders for emergencies such as hazardous material releases. A documented evaluation or baseline needs assessment was conducted in 1996 to identify the minimum required capabilities of the site fire department, which includes staffing, apparatus, facilities, equipment, training, fire pre-plans, offsite assistance requirements, and procedures. Fire hazards surveys and emergency-planning hazards assessments were also used for determining requirements and resources needed for effective emergency response. Further, in accordance with NFPA 1620, *Recommended Practice for Pre-Incident Planning*, HFD developed pre-plans, which include minimum staffing to establish water flows within individual facilities and address facility hazards.

Hanford Fire Department Equipment

Specific HFD responsibilities include incident command and control; fire suppression; emergency medical services and ambulance support; technical rescue; hazardous material identification, containment, and stabilization; and wildland fire fighting. HFD responds to requests from fire departments in surrounding communities under mutual aid agreements and state mobilization agreements for fire fighting and provides initial response to the Federal and state fish and wildlife services for wildland fires. Additionally, they provide hazardous material and emergency medical support to Energy Northwest and other commercial entities operating onsite. Required HFD capabilities to respond effectively to facility fires and related emergencies are documented in the baseline needs assessment; however, they are not comprehensively manifested in facility authorization basis documents, fire hazards analyses, safety analysis

reports, and the Justification for Continued Operation because development of such documents did not credit the HFD capabilities.

The 1996 baseline needs assessment for the HFD was based on a hazardous material incident and medical emergency scenario. It identified the types and quantities of equipment that should be maintained at each of the four site fire stations; the numbers of personnel that should be on duty at all times; and the training required to support structural, hazardous material response, wildland fire, and medical emergencies. A review of the 1996 baseline needs assessment determined that the recommendations have been implemented with the exception of long-range capital projects, such as the consolidation of two fire stations into one at a new location. HFD has increased its capabilities beyond those specified in the baseline needs assessment by purchasing additional wildland fire equipment. A second baseline needs assessment will be performed in the fall of 2001 to determine if the present equipment is acceptable in the context of the evolving mission of the Hanford Site. RL and ORP should ensure that the upcoming baseline needs assessment addresses the optimal location for a new fire station based on current safety documentation and response time requirements, the availability of proper emergency equipment, and minimum staffing levels to support safe onsite operations and off-site response requirements in Mutual Aid Agreements.

The baseline needs assessment may no longer accurately reflect needed emergency response capability in the 100 Area.

Central Fire Department

Subsequent to the publication of the 1996 baseline needs assessment, conditions in the 100 Area changed, with a significant increase in the number of workers and the hazardous nature of work activity. The HFD is aware of this situation and will reassess the level of emergency response capability in the 100 Area in the update to the baseline needs assessment.

The site is organized into four areas with a fire station located in each area. A walkthrough of all four fire stations found that the various fire apparatus and equipment is well maintained and in accordance with NPFA 1500, *Fire Department Occupational Safety and Health Programs*. Further, the equipment inventory, based on the apparatus checklist, is complete. Protective clothing for wildland fire fighting is available and in good condition. The baseline needs assessment identified a need for an incident command vehicle, and HFD has purchased one.

Staffing levels are consistent with the 1996 baseline needs assessment. All HFD emergency response personnel meet the requirements of the NFPA 1001, *Fire Fighter Professional Qualification*, and are certified by the State of Washington. In the area of wildland fire fighting, all HFD emergency response personnel are trained and qualified in accordance with the National Wildfire Coordinating Group Wildland Firefighter II, National Red Card qualifications. As required by the State of Washington, only personnel trained in accordance with National Wildfire Coordinating Group standards can fight wildland fires. Additionally, all firefighters must be qualified as emergency medical technicians. The review of training records indicated that some firefighters and officers received additional training and qualifications on their own time and expense in advance of the fiscal year 2002 training budget. The additional qualifications received included positions such as crew boss, strike team leader, incident commander level 3 and level 4 logistic section, and medical unit leader.

The hazardous material response team personnel are trained consistent with the requirements NFPA 471, *Responding to Hazardous Material Incidents*, and NFPA 472, *Professional Competence of Responders to Hazardous Material Incident*. They are certified by the State of Washington. The hazardous material response team is also trained and equipped (detection equipment is located on the fire trucks) to respond to chemical and biological hazard material incidents. The State of Washington certifies emergency medical responders and all are trained to the emergency medical technician level; some are

trained to the paramedic level. HFD paramedics should attend the REACT's training class to enhance their knowledge in handling radiological response. The medical program is conducted under the authority of the Mid-Columbia Emergency Medical Service and Trauma Council, and operates under the County Medical Director for purposes of administering medication. The staffing levels and training are consistent with the baseline needs assessment and the training is in accordance with State of Washington requirements, which the state audits to ensure compliance.

HFD has established an effective relationship with the offsite emergency response community. Offsite emergency response obligations are defined and documented in formal agreements. HFD has a cooperative agreement with the U.S. Fish and Wildlife Service and is also part of the Tri-County Mutual Aid Agreement, which includes 17 agencies and the neighboring cities (e.g., Richland, Pasco, and Kennewick). However, there is no provision in the Tri-County Mutual Aid Agreement concerning training requirements or addressing whether offsite response teams would be used to support emergencies in radiation or contamination areas. The Tri-County Mutual Aid Plan should be revised to reflect that off-site emergency personnel will not support an emergency in a radiological or hazardous contaminated area. If the Tri-County Mutual Aid Plan is not revised, then RP and ORP should provide site familiarization tours of hazardous and radiological contaminated area, and training to off-site emergency service organizations. Under the Tri-County Mutual Aid Agreement, all available mutual aid resources will respond when a fire exceeds the capabilities of the existing resources. Washington State law allows statewide mobilization to obtain needed resources, and statewide mobilization procedures were used in the Command 24 fire. HFD attends monthly coordination meetings with offsite representatives of the Mid-Columbia Emergency Medical Service and Trauma Council and the Tri-County fire chiefs. At these meetings, lessons learned from actual events are discussed, such as those associated with the wildland fires of calendar year 2000.

Review of the corrective actions implemented in response to the December 2000 *Initial Joint Review of Wildland Fire Safety at DOE Sites* indicated that those actions assigned to the HFD have been completed. For example, HFD purchased programmable radios to eliminate the problems of communication within the tri-county area.

APPENDIX A
SITE BACKGROUND

RL, FHI, and subcontractors are responsible for ensuring the effectiveness of fire safety systems and programs across much of the Hanford Site. ORP, CHG, and a series of subcontractors are responsible for ensuring the effectiveness of fire safety systems and programs at the River Protection Project. Figure 2 provides a simplified diagram of those organizations having fire safety program responsibility.

Hanford Site. The 586 square mile Hanford Site, located in southeastern Washington State, played a pivotal role in the nation's defense for more than 50 years, beginning in the 1940s with its creation as part of the Manhattan Project. According to the Hanford Remedial Action Environmental Impact Statement and Comprehensive Land-Use Plan (DOE/EIS-0222-F), about 4 percent of the site is surface-contaminated and 30 percent of the site overlays groundwater contaminated from the past production of defense nuclear materials. Accordingly, the site is vigorously pursuing three cleanup outcomes as part of its overall mission: (1) restoring the Columbia River Corridor, (2) transitioning the central part of the Hanford Site for waste treatment and long-term storage, and (3) putting DOE's assets, including the Pacific Northwest National Laboratory, to work solving regional and global environmental problems. The Hanford Site employs a workforce of approximately 11,000 with an annual budget of nearly $1.4 billion.

Control Panel at the Waste Encapsulation and Storage Facility

DOE leases some of Hanford's land to the State of Washington, which in turn leases it out for two independent operations. U.S. Ecology operates a low-level waste burial ground for commercial waste, and Energy Northwest, a consortium of public utility companies, oversees the northwest's only operating commercial power reactor.

In May 1989, DOE, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology signed the landmark Hanford Federal Facility Agreement and Consent Order, commonly known as the Tri-Party Agreement in which the HFD equipment, facilities, and personnel are listed in the Part B Recruit Section of this agreement. This Agreement outlines legally enforceable milestones for Hanford cleanup over the next several decades.

The Hanford Site is managed by two DOE organizations. RL manages the non-tank waste portion of Hanford's environmental management mission as well as Hanford's science and technology mission, which supports both the tank and non-tank environmental management missions. ORP manages the tank waste portion of Hanford's environmental management mission (i.e., the River Protection Project), including the 242-S Evaporator and cross-site transfers. FHI is the management and operating contractor responsible for operation and cleanup of non-tank farm facilities at the Hanford Site (including the PFP, the Waste Receiving and Processing Facility, and WESF).

ORP Tank Farms. Since 1944, highly radioactive waste from the chemical processing of irradiated reactor fuel has been stored in underground storage tanks and in capsules at the Hanford Site. Approximately 54 million gallons of caustic liquid, salt cake, and sludge are currently stored in 177 underground storage tanks in 18 tank farms. The tanks and capsules represent about 60 percent (by volume) of the nation's radioactive waste and 80 percent (by radioactivity) of the Hanford Site's radioactive waste resulting from nuclear weapons development. The Hanford tank farms are one of two DNFSB 95-2 priority facilities at Hanford.

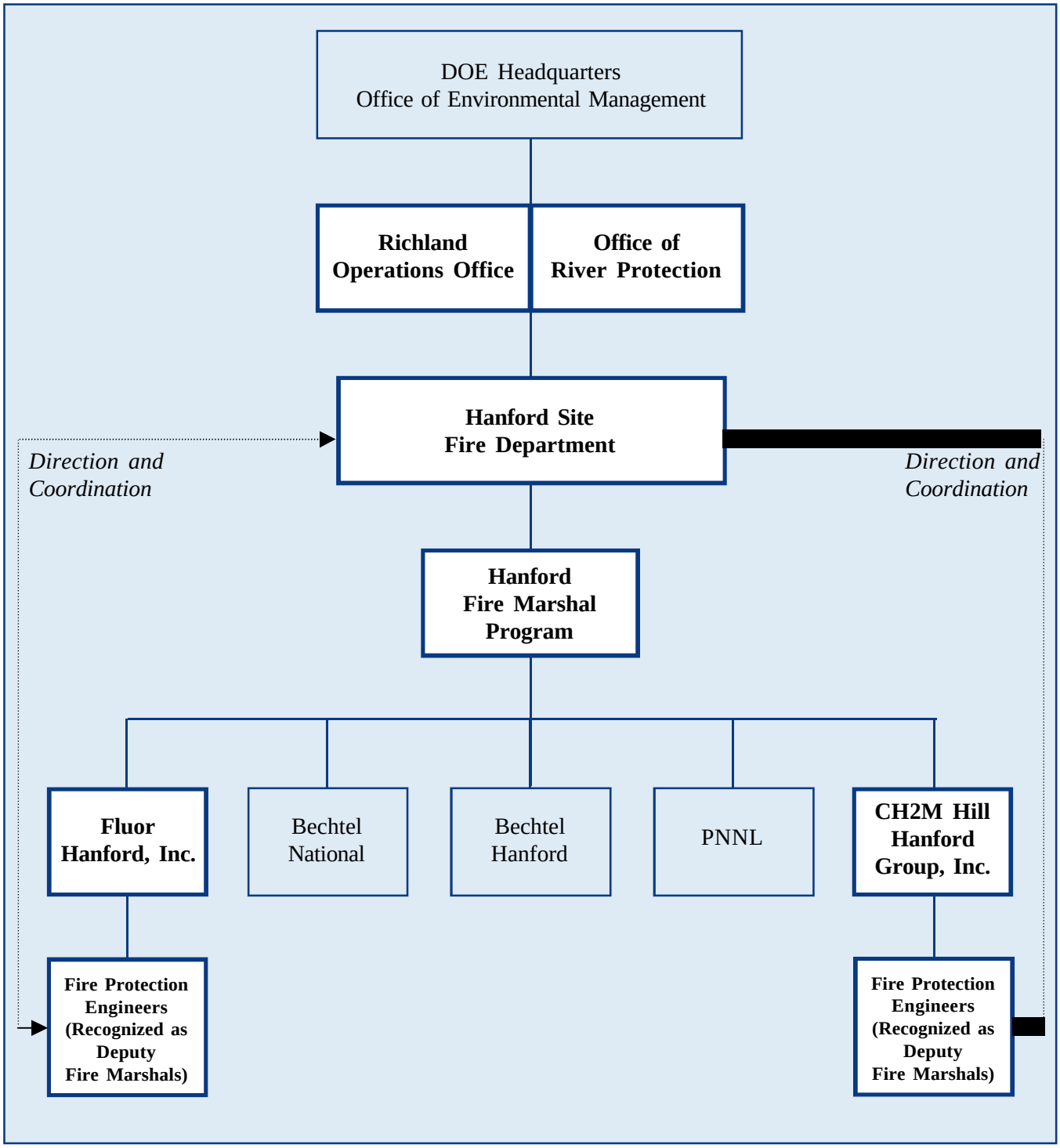


Figure 2. Hanford Site Fire Protection Program

During the mid-1990s, management of the Hanford tank farms was included as part of the Tank Waste Remediation System program. In 1996, the Tank Waste Remediation System program was incorporated into the RL scope. In December 1998, the DOE established ORP, as directed by the Congress in Section 3139 of the *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999*, to execute and manage the River Protection Project.

The mission of the River Protection Project, which encompasses all programmatic activities formerly conducted under the Tank Waste Remediation System program, is to store, retrieve, treat, and dispose of the highly radioactive Hanford Site waste in a safe, environmentally sound, and cost-effective manner. In support of this mission, ORP established two prime contractors that are responsible for executing the assigned project work scope – a tank farm contractor and a waste treatment contractor. In October 1999, Lockheed Martin Hanford Company was established as the prime tank farm contractor to ORP. In December 1999, CHG assumed the ORP prime contract following the sale of the Lockheed Martin Hanford Company to CHG. CHG is responsible for tank waste storage, waste retrieval, interim storage of high-level immobilized waste, disposal of low-activity waste, and waste feed delivery to the waste treatment contractor. Bechtel National is the waste treatment contractor responsible for design, construction, and commissioning of the Hanford Tank Waste Treatment and Immobilization Plant.

Facility Descriptions

PFP. The PFP houses a large inventory of radioactive and chemical materials from defense production activities at PFP and at other DOE facilities during the Cold War. PFP's inventory includes 4 metric tons of plutonium contained in nearly 18 metric tons of bulk materials in a variety of forms. These include metals, powders, solutions, residues, and polycubes. Much of this inventory requires stabilization before shipment. PFP is located in the 200 West Area.

Waste Receiving and Processing Facility. The Waste Receiving and Processing Facility processes and packages transuranic, low-level, and mixed waste for shipment to the Waste Isolation Pilot Plant. The Waste Receiving and Processing Facility is located in the 200 West Area and is the Hanford Site's first major solid waste processing plant. Construction of Waste Receiving and Processing Facility began in 1994 and this facility has been operating since 1997.

WESF. The WESF was constructed on the west end of B Plant in the early 1970s and began operation in 1974 to encapsulate and store strontium and cesium that had been removed from high-level radioactive waste storage tanks. The isotopes have been doubly encapsulated in 22-inch long metal containers and stored in 13-foot deep pools of water, providing cooling and radiation shielding. WESF stores 1,936 capsules of cesium and strontium, containing approximately 131 million curies of radioactivity. WESF is located in the 200 East Area.

Cross-Site Transfers. Cross-site transfer activities involve the movement of wastes from single-shell tanks in the 200 West Area to double-shell tanks located in the 200 East Area. The six original single-walled transfer lines did not meet current regulatory standards and have been replaced by two lines – each consisting of two stainless steel pipes surrounded by a carbon steel pipe. The transfer lines run from the SY Tank Farm (in 200 West Area) to the 244-A Lift Station (in 200 East Area).

242-S Evaporator. The 242-S Evaporator-Crystallizer facility, located in the 200 West Area, operated from 1973 to 1980. The facility was used to reduce the volume of radioactive liquid waste by evaporating water from the feed to produce a concentrated salt solution. Over its operating life, this evaporator boiled off nearly 42 million gallons of water and produced about 12 million gallons of wet salt cake. The facility is currently in a standby/shutdown condition.

APPENDIX B
VITAL SAFETY SYSTEMS REVIEW

B.1 Introduction

This appendix provides the details of the vital safety systems review conducted as part of the August 6-16, 2001 *Comprehensive Fire Safety Review: The Hanford Site*. The primary objective of this vital systems review was to evaluate the "health" of selected fire protection systems at the Hanford Site. For the fire protection systems reviewed at the Hanford Site, the team concluded that:

- Technical safety requirements have not been developed for the Hanford Site water delivery system nor has apparent age-induced pipe degradation in the system been analyzed to assure that a sufficiently reliable source of water is maintained available for suppressing a design basis fire originating in Building 2736-ZB, and
- Implementation of configuration management and maintenance programs, in some cases, does not assure defense-in-depth protection of vital fire protection systems.

In Recommendation 2000-2, the Defense Nuclear Facilities Safety Board (or Board) identified recommendations to improve the configuration management of vital safety systems, and defined vital safety systems as safety-class, safety-significant, and defense-in-depth. A September 8, 2000, letter to the Secretary of Energy amplified the intent of Recommendation 2000-2 and defined the basic thrust of the Board's Recommendation to be the assessment of the operational readiness of vital safety systems. The Board stated that as facilities age, a combination of degradation and less than effective implementation of preservation programs (e.g., change control, upgrades, and maintenance) could affect system reliability and ability to perform design safety functions. The Board concluded that the Department's operating contractors are not always giving equipment that is designed to serve vital protective functions the attention such equipment deserves.

On October 31, 2000, the Department provided its initial Implementation Plan for Recommendation 2000-2, *Configuration Management, Vital Safety Systems.* The plan defined practices that enhance the Department's ability to apply engineering expertise to maintain and operate vital safety systems for protection of the public, workers, and the environment. It also addressed a near-term objective of completing a baseline assessment of the operational readiness of vital safety systems. Specifically, the plan describes the implementation of a phased approach to assess the current operational readiness of vital safety systems and assess key facilities and/or systems where operability may have degraded.

During the first phase, operating contractors, overseen by Federal field office personnel, performed an initial Phase I assessment of vital safety system operational readiness (Commitment 3). This was to be accomplished by identifying the vital safety systems within defense nuclear facilities of interest; reviewing existing operational and maintenance records; and qualitatively determining a readiness state for each vital safety system within these facilities. A basic set of criteria was developed to guide the performance of the initial Phase I assessments and ensure consistency.

Once Phase I assessments were complete, the Department committed to evaluate the results and identify key facilities and/or systems where issues or concerns were identified regarding the operational readiness of vital safety systems (Commitment 6). Certain of these key facilities and/or systems were to be further assessed (Phase II assessments) using a vertical slice of key facilities and systems by assembling teams to tailor assessment criteria and perform a detailed assessment of the operational readiness of systems (Commitment 7).

This vital system review evaluates the operability of the selected fire protection systems at the Hanford Site. As such, the results may provide information to the Hanford Site's 2000-2 Phase II assessment process.

B.2 Approach

Vertical slice methods were used to review portions of the PFP, WESF, and 242-S fire protection systems and to evaluate the 2000-2 Phase I assessment results for these systems. Selected PFP fire protection systems were first reviewed and the results were applied to more narrowly focus the reviews conducted for WESF and 242-S. During the review, performance objectives and criteria similar to those used in the 2000-2 Phase I assessment process were used. The fire protection subsystems selected for review are as follows:

- PFP - Fire Water Supply and Automatic Sprinkler System
- WESF - Automatic Sprinkler System and Fire Detection and Alarm
- 242-S - Automatic Sprinkler System.

B.3 Observations

Plutonium Finishing Plant

2000-2 Phase I Assessment. A review of the Phase I assessment methodology used for the PFP Fire Protection System confirmed that it was evaluated using the Criteria and Review Approach Document produced in support of Commitment 1 of the Department's plan for Board Recommendation 2000-2, *Configuration Management, Vital Safety Systems*. As required by the Department, the Phase I assessment employed a round-table or tabletop methodology. In general, round-table discussions involved facility senior management, line management, the responsible Design Authorities (System Engineers), the facility Chief Engineer, the Operating Safety Requirement Subject Matter Expert, the Fire Protection Safety Engineer, and the Authorization Basis Team Leader. Observers at several of these sessions also included the RL Facility Representative, several RL Function Area Representatives, and the Defense Nuclear Facilities Safety Board Field Representative.

During the EH-2 review, the team found that significant concerns regarding the design basis and operability requirements for the fire protection system were unresolved. Specifically, a new fire hazards analysis, completed prior to the Phase I assessment, had raised substantial questions about the adequacy of the analyses and assumptions presented in the fire hazards analysis of record regarding the maximum possible fire loss scenario at PFP. The new fire hazards analysis concluded that the maximum possible fire loss would result from a postulated fire that would reach flashover temperatures and would, therefore, involve the entire hot side of 2736-ZB. In addition, the maximum temperatures were calculated to be sufficient to rupture all food pack containers, welded containers, and drums, and sufficient combustion by-products would be generated to clog the high efficiency particulate air filters, thereby causing their failure due to excessive differential pressure. Therefore, the new maximum postulated fire would result in PFP exceeding its onsite and offsite accident dose limits creating a positive unreviewed safety question for the facility.

At the time of the 2000-2 Phase I assessment, RL had declared an unreviewed safety question and was evaluating a Justification for Continued Operation (JCO HNF-7616) addressing this issue. Although, the Phase I assessment appropriately identified the unreviewed safety question, the subsequent evaluation of the Phase I assessment results pursuant to Commitment 6 failed to fully recognize and account for the significance of these concerns in rating the system "Green" or satisfactory.

Additionally, the team identified a safety deficiency concerning the lack of technical safety requirements for the Hanford Site water delivery system and a failure to fully analyze the potential impact of age-induced buried pipe degradation on fire protection system operability as described below. Pursuant to DOE Recommendation 2000-2 implementation guidance, the water delivery system was identified during the PFP fire protection system Phase I assessment as a vital support system and the Criteria, Review and Approach Documents (CRADs) were not applied. The team believes that guidance to exclude support systems from the Phase I CRADs, while screening vital systems from Phase II based upon Phase I results, may result in significant safety deficiencies in support systems remaining unknown to the Department.

System Authorization Basis. The authorization basis of the system is described in HNF-SD-CP-SAR-021, Rev 2. On January 19, 2001, FHI notified DOE of a potential unreviewed safety question regarding a large flashover fire in Building 2736-ZB that would possibly result in PFP exceeding the offsite dose limits for the facility (Occurrence Report RL-PHMC-PFP-2001-001). The unreviewed safety question identified a discrepancy between the then current PFP Fire Hazard Analysis (SD-CP-FHA-004, Rev 0) and a draft fire hazards analysis developed to support the W-460 Project (HNF-6385, Rev 0) issued for review on December 15, 2000.

According to the fire hazards analysis of record, the maximum possible fire loss for 2736-ZB would result from a postulated fire starting in the non-destructive assay laboratory and involving all of the office spaces on the backside. The automatic sprinkler system was expected to limit the fire; however, the analysis assumes that upon failure of the sprinkler system, the fire would still be confined to only those affected areas and would not spread to the vaults or the front side. Therefore, the maximum postulated fire would not breach confinement, and onsite and offsite accident doses would remain within acceptable limits. Based, in part, on this analysis, the existing 2736-ZB fire protection system was designated as general service. However, new queries raised by the fire hazards analysis about the adequacy of the current analyses concluded that due to flashover and postulated high efficiency particulate air

filter failure, the maximum possible fire would cause a release of radioactive materials that would exceed the allowable onsite and offsite accident dose limits.

On May 21, 2001, FHI submitted a Justification for Continued Operation providing mitigating actions including new limiting conditions of operations on the fire protection system to justify continued operation of the facility (JCO HNF-7616). On May 23, 2001, RL approved the Justification for Continued Operation with conditional requirements that FHI provide RL with a detailed control strategy for fire accident scenarios by September 30, 2001. The activities and documentation associated with the unreviewed safety question, Justification for Continued Operation, and newly proposed limiting conditions of operation were reviewed to determine the impact of these activities on the fire protection system's authorization basis. This condition, though unresolved, has the potential for substantially altering the authorization basis of the system from general service to safety significant.

Limiting Conditions of Operation Implementation. The approved Justification for Continued Operation amended the Operating Safety Requirements for the facility by establishing new limiting conditions of operations on the fire protection system. The amendment added both operability and surveillance requirements on the Building 2736-ZB fire sprinkler system and fire detection and alarm system. On August 9, 2001, the review team attended a plant review committee meeting during which a change was proposed to substantially modify the new limiting conditions of operations previously approved on May 23, 2001. The revised limiting conditions of operation simplified the condition statements and required actions and substantially reduced the completion times from 72 hours to 8 hours and 45 days to 7 days for inoperable fire sprinkler and fire detection/alarms, respectively.

During a review of the proposed limiting conditions of operations, the review team noted that the alarm/detection limiting conditions of operation does not specifically include or exclude the detection circuits located inside the gloveboxes. Additionally, the required actions for LCO 3.2.4.1.A and LCO 3.2.4.2.B did not follow the same convention. Further clarification of these inconsistencies may be warranted.

Water Delivery System. PFP fire suppression water is dependent upon the Hanford Site water delivery system. The water mains around PFP are looped and grided and are supplied by two 12 inch mains fed by potable water from a 3 million gallon reservoir and a 1.1 million gallon above ground stored water tank to ensure that fire flow demands are met. The pumps, valves and water mains meet or exceed NFPA and DOE fire protection requirements.

Adequate maintenance and upgrades of the system are not only required to provide reliable support for the critical programmatic Hanford Site missions, but also to mitigate PFP design basis accidents. Recent upgrades to the 200 Area water plants (for example, the B604 Project) have improved the overall system production efficiency and reliability. However, as identified in the Hanford Site Water System Master Plan, September 2000 "…the underground pipelines that make up the water delivery system have deteriorated to the point where replacements are required…Recently, the pipelines across the Site have experienced failures at an alarming rate."

A limited examination of data by the EH-2 review team indicates that over the past 5 years, piping failures have occurred in various sections of the Hanford Site's water delivery system. Although none of the identified failures directly impacted the operability of PFP fire protection systems, they may provide invaluable indicators of the reliability and material condition of water delivery system piping servicing PFP of similar vintage and/or containing similar quality water. Failures noted by the team included:

- Site #1 8" Potable Water Line 200 East – March 1997
- Site #2 12" Potable Water Line 200 East – July 1997
- Site #3 24" Export Water Line 200 West – September 1995
- Site #4 24" Export Water Line 200 East – July 1997
- Site #5 24" Export Water Line 200 West – February 1999
- Site #6 20" Raw Water Line 200 West – February 1999
- Site #7 3" Potable Water Line 200 East – April 1999
- Site #8 8" Potable Water Line 300 Area – April 1999.

The lack of formal analyses of the generic implication of this and similar failure data (particularly the condition of potable water lines and failure modes) as indicators on the future reliability of the Hanford Site water delivery system and its ability to support the Building 2736-ZB fire protection system's design basis is of concern to the team.

In September 2000, FHI prepared on behalf of Dyn Corp, a Water System Master Plan that catalogued and prioritized the underground water distribution mains.

A resultant matrix ranked each section of main piping based on the likelihood of failure and the potential to contribute to the spread of contamination across site. Of the 144 sections of piping, the two in-service 12-inch mains supplying the PFP sanitary loop and the loop itself were rated as 24 of 144, 84 of 144, and 8 of 144, respectively. These ratings, however, are primarily based upon environmental and utility supply criteria. The potential for failure has not been reevaluated against the more severe nuclear consequences resulting from a fire as documented in the revised Building 2736-ZB design basis fire analysis.

Interviews with utilities management personnel indicated that they were unaware of the current nuclear safety implications associated with the water delivery system to PFP. Although the deterioration of the underground piping is recognized, utilities management indicated that a current moratorium on capital expenditures would preclude near-term piping replacements in fiscal years 2001 and 2002.

In addition to the lack of analyses of the potential for degraded material condition of buried water delivery piping servicing PFP, recent water delivery system hydraulic transients (i.e., water hammer) raise additional concerns regarding their possible effect on both the water delivery system and the ability of the fire suppression systems within PFP to mitigate the consequences of a design basis fire in originating in Building 2736-ZB. Recent modifications to the pumping supply configuration have reduced the magnitude of pressure transients on the overall system and apparently reduced water delivery system piping failure rates. However, there remains evidence that PFP's location at the end of the delivery system and removal of the PFP high tank from service have reduced the system's capability to dampen pressure surges. Being located at the end of the delivery system increases PFP's vulnerability to upstream configuration changes including pump cycling. The latest hydraulic transient was recorded in the July 17, 2001, PFP BED log. The effects of this hydraulic transient, as well as previous events, have not been evaluated with respect to their continued effect on PFP fire suppression piping and hangers. The Fire Protection Water Supply Analysis, WHC-SD-SQA_ANAL-30001, Rev. 0, dated August 1995, recommended that an engineering evaluation be completed and required that modifications be implemented to correct water surge problems in the 300 Area. However, the report did not identify or address surge problems in the 200 West Area.

An ancillary concern was raised regarding foreign object debris in the water delivery system. HFD maintenance service personnel indicated that fire hydrant tests have failed due to flow blockage from materials such as tire chalks and rocks. It was indicated that these conditions were usually discovered after repairs or replacements had been performed on sections of buried pipe. Since the fire suppression systems at PFP are supplied by potable water, this issue does not appear to be of significant concern for the facility.

Water Delivery System Operations. A walkdown of the water distribution system from the river (Building 181B) to PFP identified several conduct of operations observations. Many of these observations were observed on portions of the water delivery system that is not required to support fire protection functions at PFP. However, they have been included below to ensure evaluation for corrective action, as well as, evaluation for their potential generic implications on portions of the system required to support PFP.

- An audible alarm was received while the review team was in the 182B export system control room; however, an annunciator light did not illuminate. When asked, the operator performed an annunciator test, which revealed that the flume high-level light did not illuminate. A review of the "182 Building Housekeeping and Equipment Check List" indicated that the monthly annunciator check, which is to be performed within the first week of each month, had not been completed as of the date of the observation (August 7, 2001).
- An operator aid was observed on the river control screen controller delineating eight operational and verification steps. Operator actions that are more than informational should appear in an operating procedure.
- An uncontrolled cardboard tag-out was observed attached to the Veeder-Root Underground Storage Tank Monitoring System. The inscription on the tag read, "Power turned off per WB-00-5782/C Breaker 34 on Lighting Panel B opened 9-25-00."
- The Utility Operator Qualification Manual refers to the Pomona Turbine Pumps in Building 181B as 2,400 volt, which is contrary to the pump's nameplate data that identifies the voltage rating as 2,200 volt.
- Utilities management indicated that a preventive and predictive maintenance program governing buried piping does not exist.
- TSR surveillance requirements have not been established on the water delivery system to assure the operability and safety significant functioning of the PFP fire protection systems during a design basis fire originating in Building 2736-ZB.
- Interviews with utilities management confirm that there are no abnormal or off-normal procedures

governing the water delivery system, which would be used to re-establish firewater flow in the eventuality of a line rupture or leak. Additionally, there are no procedures governing the manipulation of the recently installed cross transfer line between 200 East Area and 200 West Area. However, utilities personnel do perform monthly valve position verifications from filter valves to facility demarcation valves.

Collectively, the lack of (1) analyses of the impact of buried pipe failures and hydraulic transients, (2) buried pipe inspections and predictive maintenance, and (3) technical safety requirements and procedural controls on the water delivery system represents a significant safety deficiency in light of newly calculated offsite and onsite accident dose projections in excess of 600 rem and 27,000 rem, respectively for a design basis fire originating in PFP Building 2726-ZB.

Configuration Management. Controlled fire protection system drawings were reviewed. Though fire protection system drawings are available and designated as essential drawings to be maintained current, they only depict the major riser headers in the system. Sprinkler subsystems, including sprinkler head locations, are not shown on controlled drawings. The newer sprinkler subsystems (risers 9 and 11) are apparently shown on certified vendor drawings. However, these drawings are not considered essential control drawings and are not maintained as part of the facilities controlled drawing system.

In addition, 8000 series drawings (project drawings) have not been incorporated into the drawing control system. Support drawings for Essential Systems are not being updated. H-2-99480, *Essential & Support Drawing List* (itself classified as an Essential Drawing) incorrectly identifies some support drawings as "Safety Class/Safety Significant," such as drawing H-2-80381/1-5, *Fire Protection Halon Electrical System*. Under current practice, updates to drawings designated as a safety system would be backlogged. Interviews with drawing control personnel indicate that sufficient resources are not available to address the backlog of support drawing revisions.

Hand-over-hand walkdowns of selected portions of PFP fire protection systems were conducted to evaluate system material condition, configuration, and drawing accuracy. In addition to the observations above regarding the lack of controlled drawings for the sprinkler headers, several discrepancies between the drawings and the as-built plant were identified. The current drawings do not fully depict the fire protection suppression system. Discrepancies include the following:

- Riser #11 on Duct Level is not shown on Drawing H-2-26916, Sheet 2
- Inspector Test Isolation Valve GV-2-11 is not shown on Drawing H-2-26916, Sheet 2
- Out-of-Service Water Gong at B-10 Duct Level is not tagged OSS Drawing H-2-24174, Sheet 2
- Main Drain Isolation Valve at G-7 Second Floor is not shown on Drawing H-2-26916, Sheet 3
- Riser #2 connection to PS-102-1 is not shown on Drawing H-2-26916, Sheet 5.

System and Equipment Status. Fire System Status is not being completely maintained at PFP. A partial walkdown of the PFP fire suppression system at 2736-ZB revealed a trouble light on supervisory panel SUPV-ENCL-1 indicating a problem on Zone 100 Riser 1+1A TS, Zone 113 Riser 7 PS and Zone 132, 235-5ZA PNL TR. A review of the Fire System Status Log did not show an entry for this condition. The log provides operational and configuration management information, which documents a work order, reason for the deficient condition, and/or compensatory measures such as increased fire watch frequencies. A further review of the log indicated that past panel spurious and unknown alarms have been received, silenced, and subsequently cleared at this panel. The fire protection system engineer indicated that he was aware of this recent condition, but the cause of the sporadic alarms had not been identified. He stated that diagnostics were difficult to accomplish, due in part to the lack of as-built detail on Essential Drawing H-2297481, *Fire Protection Fire Alarm System Supervisory Details*.

Physical changes to a fire protection system are made without the Design Authority's knowledge. Early in 2001 as part of the W460 project, an isolation valve was installed in the 2736-ZB wet fire sprinkler system in violation of FFPA 13. The valve was installed to facilitate future sprinkler piping tie-in. In March, after the installation was discovered by the HFD, action was taken to remove the valve. The root cause of the deficiency, however, was not corrected. Project personnel can make changes to Engineering Change Notices through a Design Change Notice. Further changes to a Design Change Notice involve issuing additional Design Change Notices. According to the system engineer, these Design Change Notices do not require Design Authority review or approval, the absence of which resulted in the W460 illegal valve installation.

Testing. A review of several closed HFD preventive maintenance work orders identified that work order 2G-01-23029/P, 2703-E, JUN, Fire Alarm Control Panel Preventive Maintenance, lacked qualitative and

quantitative acceptance criteria for voltage tests. Also HFD Test Report #:2Z-01-25116/W, 2736ZB FACP & Initiating Dev[s] Tests/Insp./PM/48M Batt. Repl lacked quantitative acceptance criteria for recorded battery voltage. Because these procedures are used site wide, this is a generic observation that applies to PFP, WESF, and 242-S. During the walkdown of 234-5Z, an unattached pipe hanger on the fire suppression system header was observed outside Door 374, Room 260.

Significant problems were observed by the team during the performance of work package 2Z-01-00892/P Preventive Maintenance, Maximo Riser Testing BFP #5 234-5Z AUG 01. The fire protection system was initially flushed as part of the test; however, the procedure did not cover this operation. Flushing the back flow valves is addressed in another procedure, which was not employed during this test. When questioned, maintainers and the system engineer indicated that due to chronic leakage of the back flow preventer relief valves, it has become standard practice to flush the valves before conducting the test to clear possible debris from valve seats and exercise the check valves. The review team concluded that this manipulation of the system preconditions the system to pass the test and, thereby, violates the intent of the test. Inaccurate test results could corrupt HFD's performance trending program data as well as those testing exemptions based upon that data.

Arriving at the pre-job briefing, maintainers thought the scheduled work was to perform corrective maintenance of the back flow preventer and to perform a test. Although the system engineer who conducted the briefing did so to the test procedure, he did have an unscheduled work package to correct the known leakage from this valve. The engineer indicated that it was the practice to perform additional work by "piggy backing" onto scheduled maintenance. The review team questioned the efficacy of performing repairs before conducting testing.

Step 4.2 of the test procedure requires that back flow prevention assembly must pass the test or the system should be isolated per the applicable company tag-out program. The review team observed a discussion regarding the applicable tag-out system to be used. Because the test on back flow preventer No. 5 failed despite preconditioning, a discussion ensued between the system engineer and the fire department maintainers regarding which tag-out system would be used to remove the back flow preventer from service. It was initially agreed to tag the system using the facility's program, but upon return of the maintainers to the facility later in the day, fire department break-away locks were hung in accordance with their program. The break-away locks were used to improve response time to return Riser 5 sprinkler system to service in the event of fire, assuming the back flow preventer was in a condition to support return of water to the riser.

Fire Protection documents governing the testing of fire protections systems at PFP may not be conservative for safety significant application. Specifically, Plutonium Finishing Plant Administration, FSP-PFP-5.8, *Volume 1, Fire Protection Systems 3.7*, Rev. 10 Change 1, was released with a June 12, 2001 effective date. This procedure calls for testing the fire protection system in accordance with HNF-RD-7899, *Fire Protection System Testing/Inspection/Testing/Maintenance/Deficiencies*. The frequencies in HNF-RD-7899 relax the requirements of NFPA 72, *National Fire Alarm Code* and apply sitewide requirements. A DOE Headquarters memorandum, "Implementation Guidance, NFPA 72, National Fire Alarm Code," September 1, 1999, excludes Category I nuclear facilities from relaxing testing frequencies. At PFP, operating safety requirements require riser flow tests to be performed quarterly, which is consistent with the code; however, HNF-RD-7899 requires the tests to be performed annually. Also within HNF-RD-7899, HFD has interpreted NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* 9-5 back flow preventer tests as annual. The validity of this frequency should be evaluated with respect to the questionable practice of system preconditioning.

Regarding relief from fire protection system inspection and testing requirements, the Hanford Site has twice petitioned and received approval to reduce testing frequencies based on reliability data collected for the Hanford facilities. The first was an exemption approved by DOE Headquarters on November 9, 1993. The second was an equivalency approved by RL in 1997. It can be noted that many of the reduced testing frequencies approved in 1993 are reflected in subsequent NFPA testing requirements.

Vendor Manuals. Current vendor manuals are not being maintained. Interviews with the Hanford Fire Protection Systems Maintenance Material Coordinator and a review of select vendor manuals indicate that administrative controls are not in place to assure receipt of vendor updates or service instruction letters. Currently, HFD Fire Protection Systems Maintenance personnel are searching for or requesting updates as equipment problems are identified. For example, recent problems associated with Pyro Chem dry chemical systems and components utilizing ECH120 and ECH24 control heads have prompted the HFD to officially

request applicable technical manuals and supplemental bulletins. Although there is no requirement for updated vendor manuals and receipt of service bulletins for General Service, Quality Level 0 systems, and components; the practice does provide increased assurance that systems, components, and sub-components will remain functional. If the Building 2736-ZB fire suppression system is reclassified as safety significant, then vendor manual controls should be required to assure system functionality.

Procurement. In anticipation of the Building 2736-ZB fire suppression system reclassification, Hanford Fire Department Fire Protection Systems Maintenance in conjunction with the PFP fire protection engineers have developed a list of Catalog Identification Numbers for 2736-ZB Fire Systems and have designated components as Safety Significant, Quality Level 2. Procurements are underway for these spare parts. Critical characteristics are being developed so that the received spare parts will undergo a commercial grade dedication to qualify them for safety significant use. Although the critical characteristics and receipt inspections have not been completely developed, procurements are being executed to assure spare parts availability. Spare parts currently in inventory will undergo a commercial grade dedication to qualify them for safety significant use. The review team noted that there is no integrated schedule to ensure that by September 30, 2001, dedicated spare parts will be available for the upgraded safety significant or safety class, 2736-ZB Fire Suppression System.

Long Standing Open Items. A previous management assessment of the Nuclear Materials Stabilization Project, performed in April 2000 (Report FEB-FY00-03), identified four long-term, unresolved discrepancies for which additional commitment is needed to resolve fire protection issues in a timely manner. The review team conducted interviews with fire protection personnel and reviewed supporting documentation to determine the status of these previously identified, long-standing open items; the results are provided in Table B-1. Based on the status

Table B-1. Long-Standing Open Item Status

Review Criteria	EH-2 Review Team Assessment of Current Status of Open Items
The 2736-ZA fire alarm panel has been intentionally "locked in trouble" for approximately 4 months to mask spurious trouble alarms that are being generated by an unidentified source… A work package exists for the troubleshooting work but has not been scheduled."	This item remains open. A review of Work Control Document 2Z-01-00989/W, T/R FCP IN 2736-ZA. SPURIOUS ALARMS indicates that the work has not been completed. The facility intends to install more reliable fire alarm panels in 2002; therefore this item will most likely remain open until the new installation is completed.
"A deficiency on zone 17 of the 234-5Z fire alarm panel has been in existence for 2 years…"	The fire protection engineer indicated that this item was closed out as part of the completion of DCN-MG0H2-015.
"A work package (2Z-98-2052) was generated in 1998 to repair a deficient fire barrier penetration between rooms 500 and 502 in the 291-Z Facility. This package still remains to be worked."	This work was completed on August 21, 2000, as indicated on work document 2Z-98-02052. However, a similar situation was discovered during the performance of a fire/smoke barrier inspection performed in March 2001, which identified a 3-inch hole filled with fireproof caulk between rooms 500 and 502 near fire door 695. This condition resulted in the generation of work package 2Z-98-00513/M, which is currently open.
"…completion of testing and maintenance routines on the fire alarm system is sporadic and is typically in an overdue status for significant periods of time…"	The fire protection system engineer indicated that work item remains open due to continuing radiological and industrial health concerns.

of the open items, the review team concluded that the additional commitment to resolve fire protection issues such as longstanding impairments has not been realized.

Waste Encapsulation and Storage Facility

The vertical slice review of the WESF fire protection system found the system to be classified as General Service as discussed in the facility's Basis for Interim Operations. A fire hazards analysis (HNF-SD-WM-FHA-019, Rev 2) was in place and concluded that the facility meets that applicable fire protection criteria stipulated in DOE Order 5480.7A. Implementation of selected assumptions from the fire hazards analysis was verified during the vertical review.

2000-2 Phase I Assessment. Review of the WESF Fire Protection Phase I assessment methodology confirmed that the system was evaluated using the Criteria and Review Approach Document produced in support of Commitment 1 of the Department's plan for Board Recommendation 2000-2, *Configuration Management, Vital Safety Systems*, and employed the same methodology and scope of participants as described for PFP. The Phase I assessment concluded the WESF fire protection system was operational, and personnel and processes were in place to ensure its continued operational readiness. No issues requiring corrective actions were identified.

Configuration Management. Review of controlled fire protection system drawings indicated the fire protection fire alarm electrical (H-2-66482) and sanitary and raw water (H-2-36535) drawings to be controlled as essential drawings. However, the fire protection sprinkler system (H-2-66544) is not designated as an essential drawing.

Hand-over-hand walkdowns of selected portions of WESF fire protection systems were conducted to compare the system drawings to the as-built configuration of the plant. The walkdowns confirmed that, in general, the active portions of the fire protection system were accurately depicted in controlled drawings.

Operational Configuration Control. During the walkdown of WESF, the adequacy of configuration controls to assure that fire protection safety significant structures, systems, and components were properly configured was evaluated. The following discrepancies were identified:

- Fire water supply lines to the east and west transmitter rooms 203 and 204 did not appear to be configured consistently. Valve WTR 6400-2 is open; however, valve ETR 6400-2 is closed. Valve WTR is closed with a tamper seal; however, ETR is closed with no tamper seal.
- The tamper seal was broken on back-flow preventer isolation valve 294-B 600-8 located in 294-B.
- A ladder blocked egress from the truck bay and the manual pull box at the exit. This discrepancy was immediately corrected by facility personnel.

Maintenance. Fire protection system maintenance and surveillance activities are mostly provided by the HFD as described above under the PFP discussion. During the walkdown of the fire protection system, a sprinkler head located in an alcove off of room 120 was found to be painted over. A fire safety concern identified in November 2000 noted that multiple fire system sprinkler heads were painted over. Discussions with the cognizant engineer and the facility management indicated that this prior concern had been corrected by replacing all painted sprinklers. Apparently, the one painted sprinkler head found during the walkdown had been overlooked by facility personnel.

242-S Waste Evaporator

The vertical slice review of the 242-S Fire Protection System found the system to be installed and operated as General Service. The 242-S Evaporator Building has a fire detection system and a fire sprinkler system installed as described in the 242-S Facility Shutdown/Standby Plan (SD-WM-SSP-002, Rev. 0). These functions are required to be maintained and available for safe standby operation of the building.

The Tank Farm Final Safety Analysis Report (FSAR, HNF-SD-WM-SAR-067, Rev. 2) does not identify any fire protection systems as safety class, safety significant, or defense-in-depth. The current Fire Hazards Analysis (WHC-SD-WM-FHA-022, Rev. 0) identifies that the potential for a significant release from the building of toxic/corrosive materials or radioactive material due to a fire incident does not exist.

2000-2 Phase I Assessment. Review of the 242-S Fire Protection Phase I assessment methodology confirmed that the system was evaluated using the Criteria and Review Approach Document produced in support of Commitment 1 of the Department's plan for Board Recommendation 2000-2, *Configuration Management, Vital Safety Systems*. The CHG Fire

Marshals accomplished the Phase I assessments for all fire systems.

The Phase I assessment concluded that the 242-S fire protection system is operating reliably and is performing its general service safety function. It also concluded that maintenance activities and response to system problems are performed well, which is evidenced by the high system availability. Procedures, design media, and policies maintain configuration control of the system. No outside source of fire could potentially harm the structure or its contents.

Configuration Management. A review of controlled fire protection system drawings indicated that the fire protection sprinkler system drawing (H-2-46421) was not designated as an essential drawing. Hand-over-hand walkdowns of selected portions of the 242-S fire protection system were conducted to compare the system drawings to the as-built configuration of the plant. The following identified discrepancies represent additional configuration management weaknesses:

- Fire protection valves are not numbered on plant drawings or labeled in the facility.
- An isolation valve in fire sprinkler header located in the northwest corner of the control room is not shown on drawing H-2-46421 (B-6).
- Change trailer fire sprinkler header and supply connection from 242-S is not shown on a controlled drawing. No Engineering Change Notice could be located covering this modification.
- Several smaller valves and check valves on the riser header are not depicted on plant drawings.

System Testing. The conduct of a periodic flow verification surveillance test by the fire department was observed. The test was completed in accordance with approved procedures and with no discrepancies.

B.4 Other Related Observations

Other configuration management and maintenance observations were identified following walkdowns of the Waste Receiving and Processing Facility. Two elements of fire suppression equipment – the wet standpipe system and the automatic sprinkler system lead-in back flow preventer – did not receive adequate inspections or maintenance.

The wet standpipes were originally installed to comply with NFPA 231, *General Storage*, which has been consolidated into NPFA 13, *Installation of Automatic Sprinkler Systems*; however, the requirement has been maintained. Reportedly, inspection and maintenance of standpipe systems has been eliminated due to cost and the HFD not being dependent on these systems. These systems have not been either isolated or tagged out as "not in service." The March 2000, Waste Receiving and Processing Facility FHA (in Section 4.2.2) takes credit for the functionality of these systems; the requirements are from Section 6.e of RLID 5480.7.

In addition, the standpipe system has inadequate isolation capabilities at the riser; closing the main lead-in control valve is the only way to achieve system isolation. If the system requires isolation because of damage or to perform maintenance, then all three building automatic sprinkler systems would require isolation. The potential for unnecessary impairments to the sprinkler systems from isolation of the standpipe system suggests that an isolation valve should have been installed at the base of the riser in accordance with NFPA 14, *Installation of Standpipe and Hose Systems, Private Hydrants, and Hose Systems.*

Back flow preventers are not being tested in accordance with NFPA 25, *Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems* (Section 9.6.2.2), which requires a full forward flow test at the calculated design flow requirements. Based on a review of the Activities Instruction for a double check valve assembly and discussions with the maintenance manager, it was determined that flow tests are not being conducted in accordance with requirements.

B.5 Safety Deficiency

As identified previously in Section B.3, one safety deficiency was identified as part of the vital systems review. Technical safety requirements have not been developed for the Hanford Site water delivery system nor has apparent age-induced pipe degradation in the system been analyzed to assure that a sufficiently reliable source of water is maintained available for suppressing a design basis fire originating in Building 2736-ZB. Degraded delivery water piping conditions and the impact of repetitive water hammer have not been addressed as part of the resolution of the positive unreviewed safety question and subsequent Justification for Continued Operation at PFP. Additionally, water supply concerns have not been effectively communicated between the utility organization and PFP. As a result, technical safety requirements have not been developed to assure sufficient reliability and availability of the water delivery system and the design basis safety significant function of the PFP fire protection system.

Table B-2. Summary of Vital System Review to Observations (PFP Fire Protection Systems)

Review Criteria	EH-2 Review Team Observations
Vital safety system safety functions are defined and understood by responsible line managers; supporting information/documentation is available and adequate. System testing is adequate to ensure operability.	• The safety basis and safety class of the 2736-ZB system are unknown. The current safety basis of the system is being reevaluated and redefined because of an unreviewed safety question based on a recent fire hazards analysis. The facility is operating under a Justification for Continued Operation until resolution. • Supply system aspects of the fire protection system were not analyzed; these include the fire pumps, and reservoirs. • Performance data on the water delivery system have not been fully analyzed for impact on fire suppression system operability in Building 2736-ZB. • At the time of the assessment, relaxed fire protection inspection and testing procedures have been approved for use that may be inconsistent with the current Operating Safety Requirement associated with the Justification for Continued Operation. • The draft PFP 2736-ZB fire system design description addresses the water supply system outside 2736-ZB as a major component of the proposed safety significant fire sprinkler and detection system, but addresses it as non-safety. • The PFP fire suppression system is being preconditioned to pass BFP testing. • The system was tested per National Fire Protection Association requirements; however, Operating Safety Requirements SRs did not exist for the system until recently. • Though essential drawings are available for the fire protection system, they only depict the major riser headers. Sprinkler subsystems, including sprinkler head locations, are not shown on controlled drawings. Additionally, several inconsistencies were identified between portions of the system included on controlled drawings and the as-built plans.
The backlog for surveillances, tests, inspections, maintenance, repair, upgrades, or other work on the system is managed and kept to an appropriate minimum.	• The PFP fire suppression system is being subjected to water hammer transients that have not been evaluated. • Previously identified, long-standing open items are not being resolved in a timely manner.
Configuration management and maintenance programs effectively ensure operational avail-ability of the system.	• Vendor manuals are not programmatically updated nor are controls in place to assure vendor bulletins and service instruction letters are received. • Support drawings related to the fire systems essential drawings are not being updated. • PFP fire protection engineers are no longer tracking and trending system deficiencies and performance. • The PFP Fire System Status Log is not current. • An example of a Fire Protection Test procedure did not contain qualitative or quantitative acceptance criteria. • Design and physical changes are made to the PFP fire suppression system without Design Authorities' knowledge.
The system is operable and available to fulfill its safety function when required.	• A positive unreviewed safety question exists on the Fire Protection System. As a result, a Justification for Continued Operation was established to allow continued operations while the operability requirements for the fire protection system were established. • Water system reliability has not been fully analyzed for its impact on the operability of the fire protection system in Building 2736-ZB. • A limiting conditions of operation was only recently approved (after Phase I) for the fire protection system that formally establishes the system operability requirements.

Table B-3. Summary of Vital System Review Observations (WESF Fire Protection System)

Review Criteria	EH-2 Review Team Observations
Vital safety system safety functions are defined and understood by responsible line managers, and supporting information/documentation is available and adequate. System testing is adequate to ensure operability.	The review team found the fire protection fire alarm electrical (H-2-66482) and sanitary and raw water (H-2-36535) drawings to be controlled as essential drawings. The fire protection sprinkler system (H-2-66544) is not designated as an essential drawing. The review team conducted hand-over-hand walkdowns of selected portions of WESF fire protection systems to compare the system drawings to the as-built configuration of the plant. The walkdown confirmed that, in general, the active portions of the fire protection system were accurately depicted in controlled drawings.
The backlog for surveillances, tests, inspections, maintenance, repair, upgrades, or other work on the system is managed and kept to an appropriate minimum.	Fire protection system maintenance and surveillance activities are mostly provided by the HFD. During the walkdown of the fire protection system, the team found a sprinkler head in an alcove off of room 120 that had been painted over. As discussed elsewhere, a fire safety concern identified in November 2000 noted multiple fire system sprinkler heads being painted over. Discussions with the cognizant engineer and the facility management indicated that this weakness had been corrected by replacing all painted sprinklers. Apparently, the one painted sprinkler head found during the walkdown had been overlooked by the facility.
Configuration management and maintenance programs effectively ensure operational availability of the system.	During the walkdown of WESF, the review team observed the adequacy of configuration controls in place to assure that fire protection Safety Systems, Structures, or Components are properly configured. The review team identified the following discrepancies: • Fire water supply lines to the east and west transfer rooms 203 and 204 did not appear to be configured consistently. Valve WTR 6400-2 is open, however valve ETR 6400-2 is closed. Valve WTR is closed with a tamper seal, however ETR is closed with no tamper seal. • The tamper seal was missing on back-flow preventer isolation valve 294-B 600-8 located in 294-B. • A ladder blocked both egress from the truck bay and the manual pull box at the exit. This discrepancy was immediately corrected by the facility. • Vendor manuals are not programmatically updated nor are controls in place to assure vendor bulletins and service instruction letters are received. • An example of a Fire Protection Test procedure did not contain qualitative or quantitative acceptance criteria. (Site-wide observation)
The system is operable and available to fulfill its safety function when required.	• Water system reliability places into question the operability of the fire protection system. (Site-wide observation)

Table B-4. Summary of Vital System Review Observations (242-S Fire Protection System)

Review Criteria	EH-2 Review Team Observations
Vital safety system safety functions are defined and understood by responsible line managers, and supporting information/documentation is available and adequate. System testing is adequate to ensure operability.	***Generic HFD observations are described in the PFP matrix***
The backlog for surveillances, tests, inspections, maintenance, repair, upgrades, or other work on the system is managed and kept to an appropriate minimum.	***Generic HFD observations are described in the PFP matrix***
Configuration management and maintenance programs effectively ensure operational availability of the system.	• Fire protection sprinkler system drawing (H-2-46421) is not designated as an essential drawing. • Fire protection valves are not numbered on plant drawings or labeled in the facility. • An isolation valve in fire sprinkler header located in the northwest corner of the control room is not shown on drawing H-2-46421 (B-6). • Change trailer fire sprinkler header and supply connection from 242-S is not shown on controlled drawing. No Engineering Change Notice could be located covering this modification. • Several smaller valves and check valves located on the riser header are not depicted on plant drawings. • Vendor manuals are not programmatically updated nor are controls in place to assure vendor bulletins and service instruction letters are received. • An example of a Fire Protection Test procedure did not contain qualitative or quantitative acceptance criteria.
The system is operable and available to fulfill its safety function when required.	• Water system reliability places into question the operability of the fire protections system.

APPENDIX C
TEAM COMPOSITION

The team membership, composition, and responsibilities are as follows:

Deputy Assistant Secretary for Environment, Safety and Health Oversight

S. David Stadler, Ph.D.

Associate Deputy Assistant Secretary for Environment, Safety and Health Oversight – Operations

Raymond Hardwick

Team Leader

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